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Kim et al.

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(54) **FILM PEELING DEVICE**

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(30) **Foreign Application Priority Data**

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B32B 43/00	(2006.01)
H01L 51/00	(2006.01)
H01L 51/56	(2006.01)

(52) **U.S. Cl.**

CPC ***B32B 43/006*** (2013.01); ***H01L 51/003*** (2013.01); *B32B 2457/206* (2013.01); *H01L 51/56* (2013.01); *Y10T 156/1132* (2015.01); *Y10T 156/1174* (2015.01); *Y10T 156/19* (2015.01); *Y10T 156/195* (2015.01); *Y10T 156/1956* (2015.01); *Y10T 156/1978* (2015.01)

(58) **Field of Classification Search**

CPC B32B 38/10; B32B 43/006; Y10T 156/1132; Y10T 156/1174; Y10T 156/195; Y10T 156/1978

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,654,016	A *	4/1972	Alexander	156/247
4,636,276	A *	1/1987	Nozaka	156/353
4,897,148	A *	1/1990	Orlandi	156/750
5,312,501	A *	5/1994	Gruber et al.	156/238
5,478,434	A *	12/1995	Kerr et al.	156/760
5,520,776	A *	5/1996	Van Allen et al.	156/759
5,540,809	A *	7/1996	Ida et al.	156/760
5,713,679	A *	2/1998	Taylor	400/621
5,766,349	A *	6/1998	Soyama et al.	118/120
6,500,298	B1 *	12/2002	Wright et al.	156/708
6,823,920	B2 *	11/2004	Gayoso	156/540
6,974,521	B2 *	12/2005	Schermer	156/247
7,686,916	B2 *	3/2010	Tsujimoto et al.	156/714
8,038,824	B2 *	10/2011	Kobayashi et al.	156/247
8,052,835	B2 *	11/2011	Merrill et al.	156/707

(Continued)

FOREIGN PATENT DOCUMENTS

KR	10-2004-0021854	3/2004
KR	10-0797572	1/2008

(Continued)

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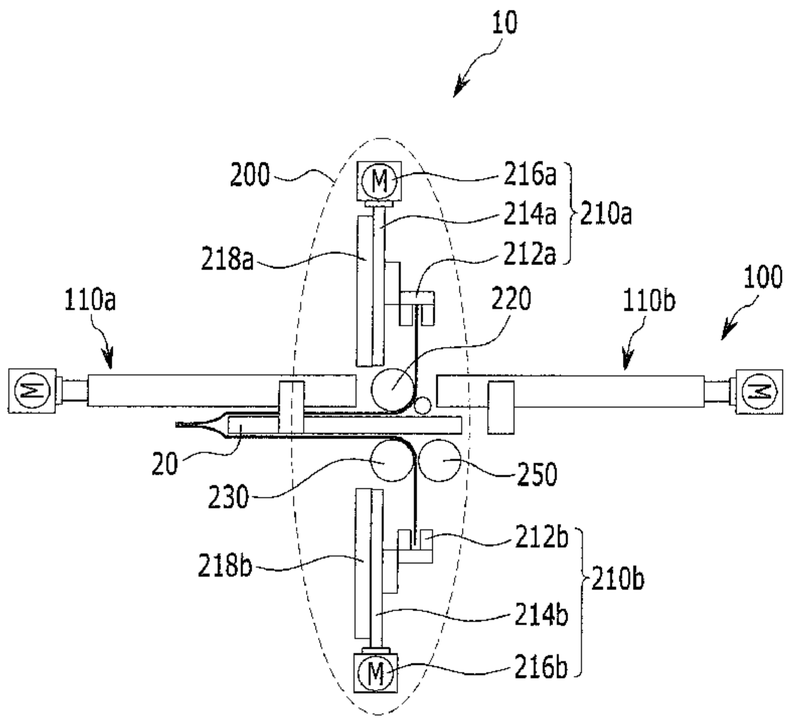
(57) **ABSTRACT**

A film peeling device for peeling a film from a substrate including a transfer module configured to transfer the substrate that is arranged in a vertical direction with respect to a bottom surface of the substrate, and a peeling module configured to peel the film from the substrate transferred by the transfer module.

16 Claims, 11 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

8,464,773	B2 *	6/2013	Hagman	156/758
2003/0029562	A1 *	2/2003	Yotsumoto et al.	156/344
2003/0121617	A1 *	7/2003	Kline et al.	156/584
2004/0069401	A1 *	4/2004	Wurdell et al.	156/247
2004/0112534	A1 *	6/2004	Koizumi et al.	156/344
2008/0302480	A1 *	12/2008	Berger	156/344
2009/0032187	A1 *	2/2009	Hiranaka et al.	156/344
2009/0120578	A1 *	5/2009	Ogawa	156/344
2009/0266486	A1 *	10/2009	Ihara	156/344
2009/0288760	A1	11/2009	Garben	
2013/0133835	A1 *	5/2013	Lee et al.	156/379.6

FOREIGN PATENT DOCUMENTS

KR	10-2008-0074619	8/2008
KR	10-2009-0017529	2/2009
KR	10-2009-0079915	7/2009

* cited by examiner

FIG. 1

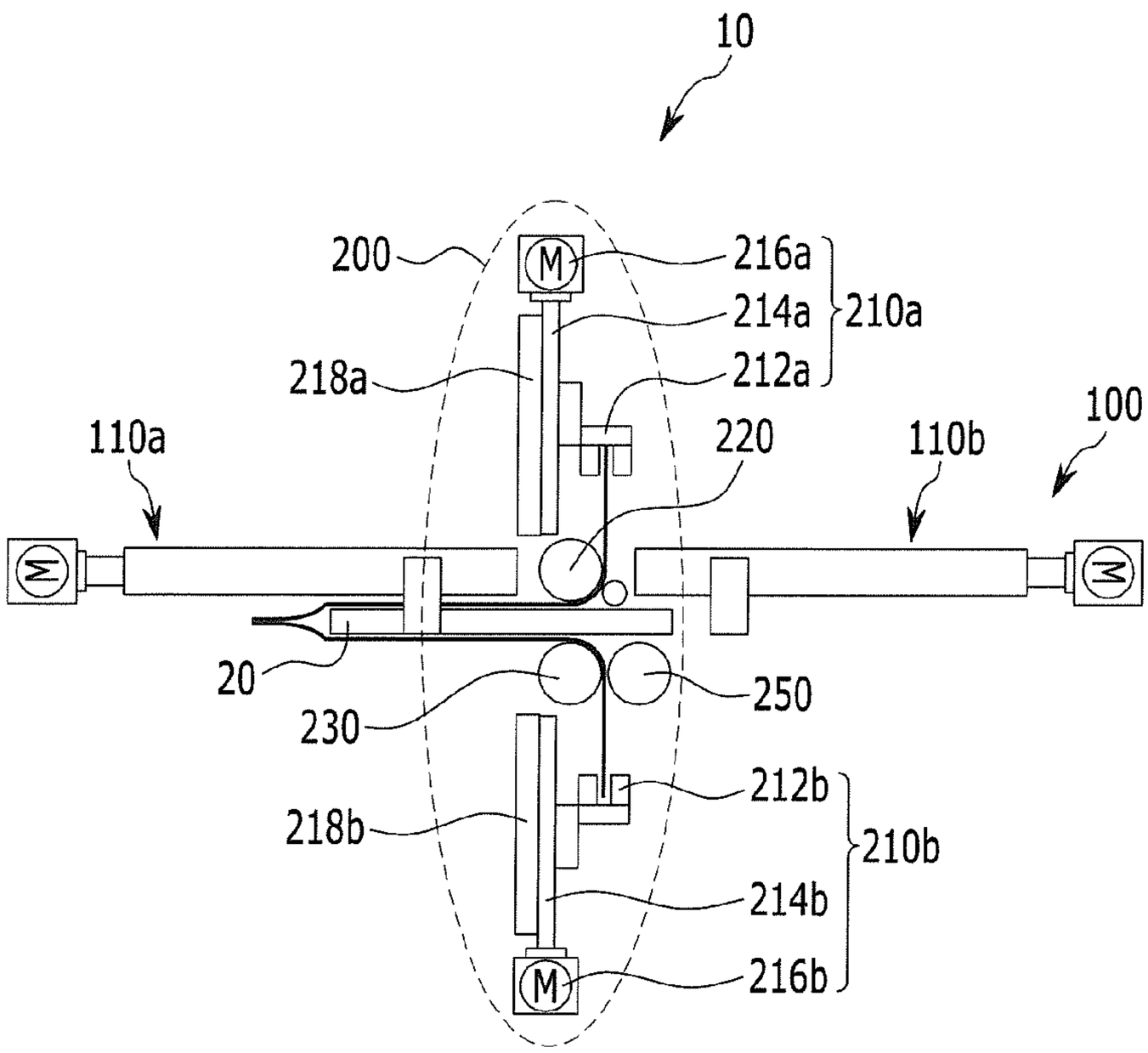
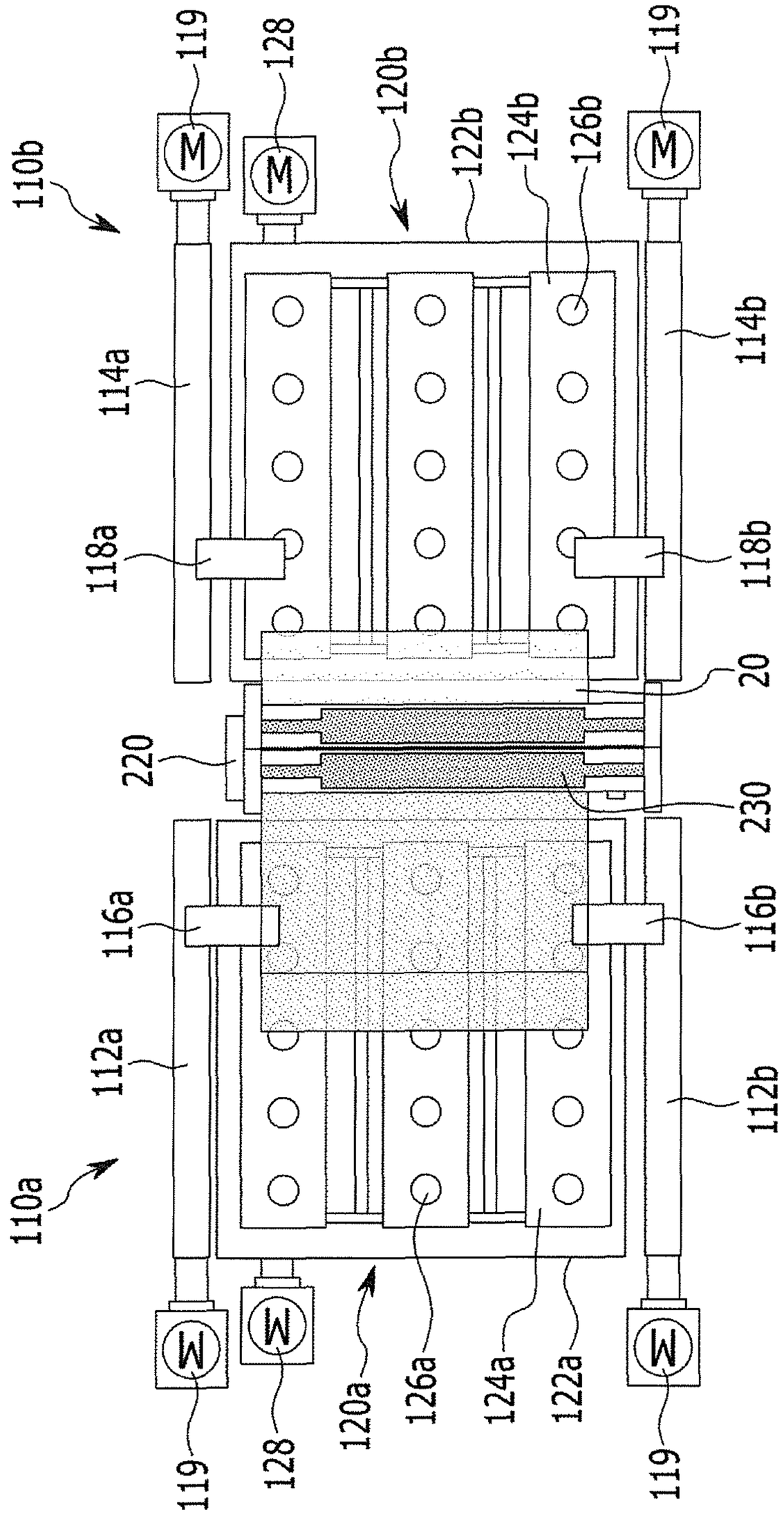

10
200
216a
214a
210a
218a
212a
100
110a
220
110b
20
250
230
212b
218b
210b
214b
216b

FIG. 2


10
110b
110a
119
128
120b
122b
124b
126b
114a
114b
118a
118b
20
220
230
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116b
112a
112b
120a
126a
124a
122a

FIG. 3

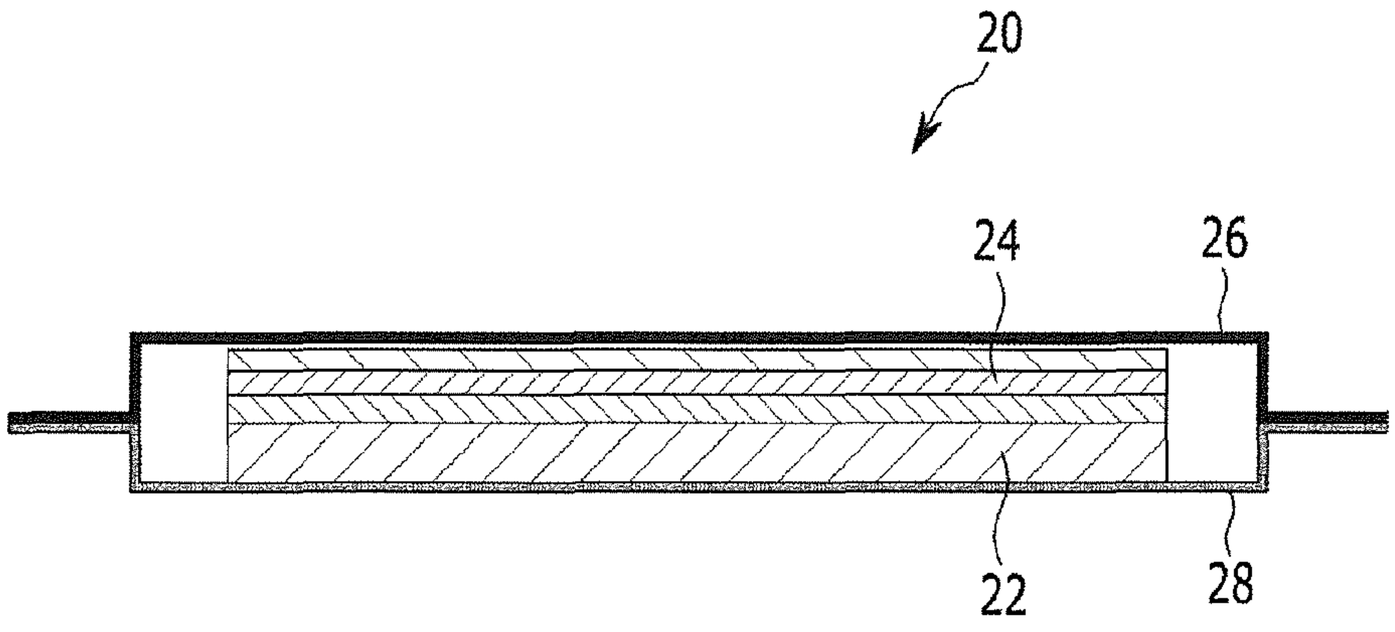


FIG. 4

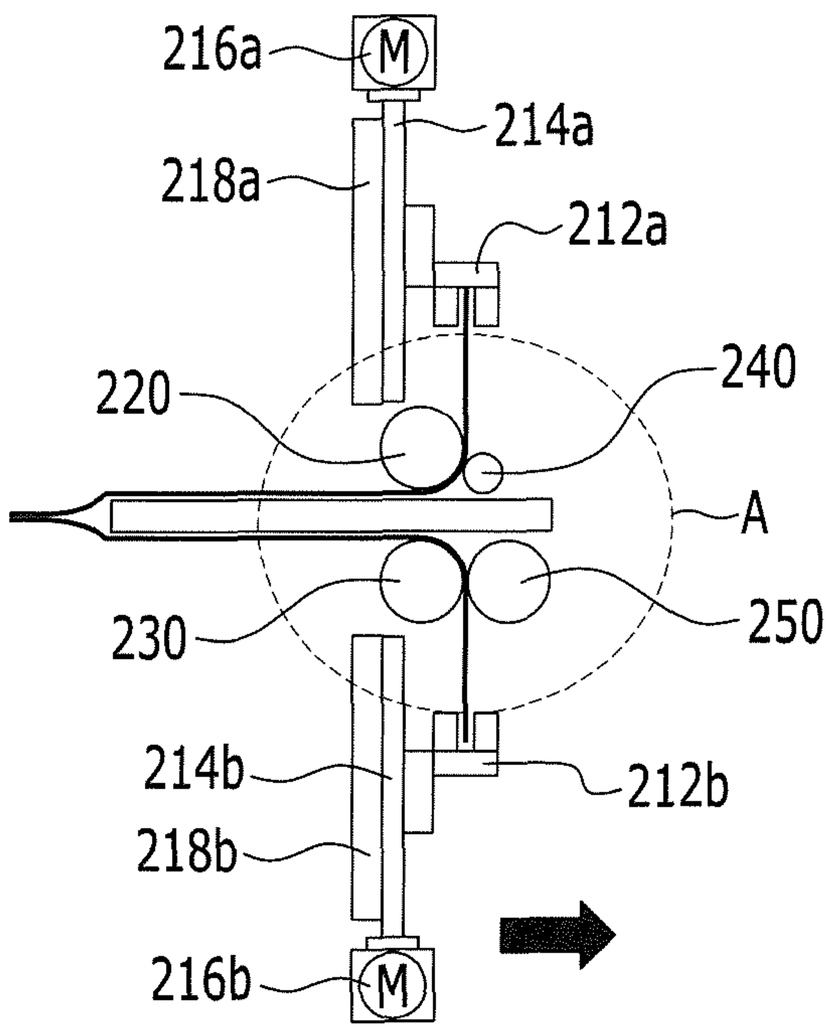


FIG. 5

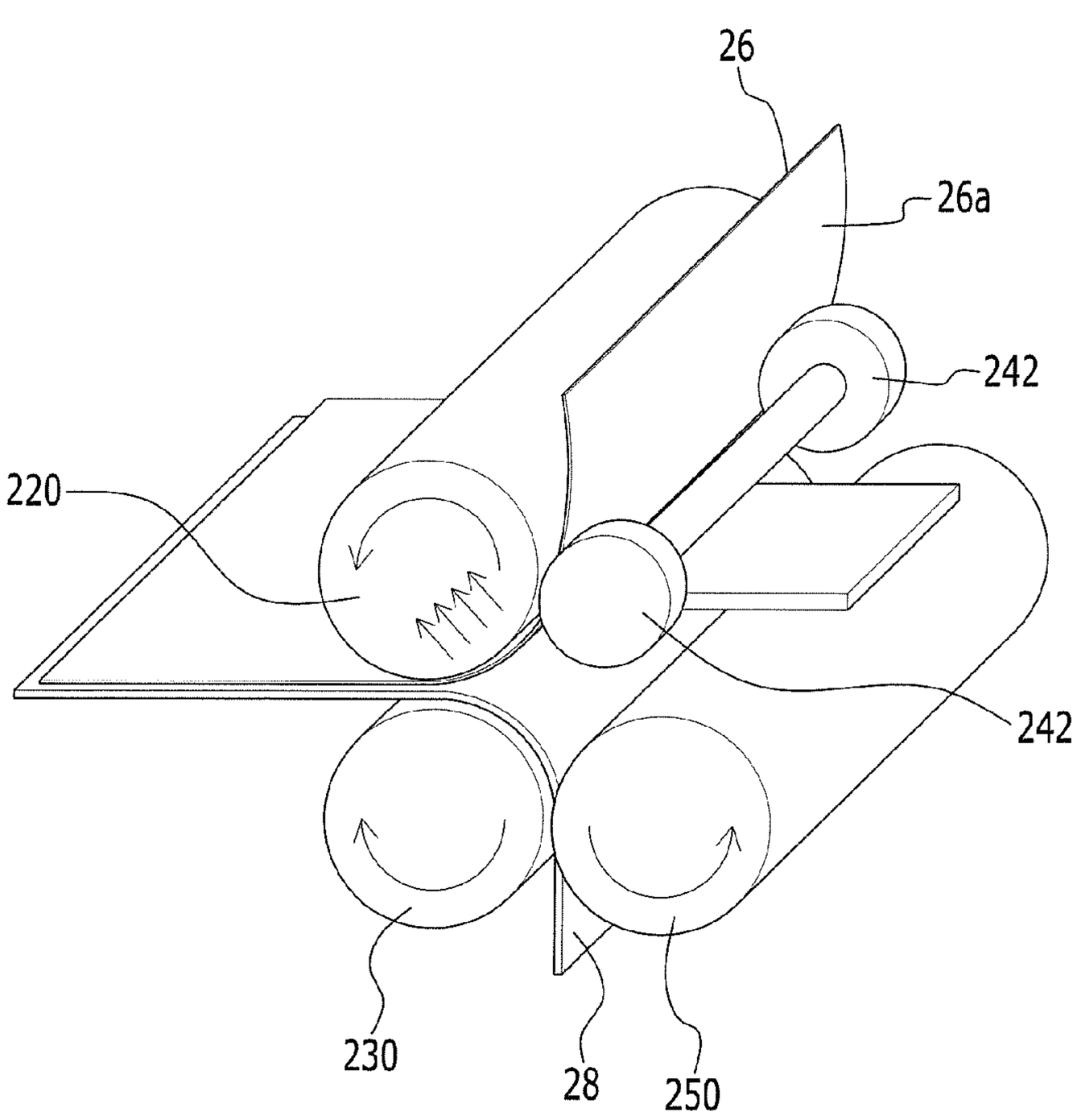


FIG. 6

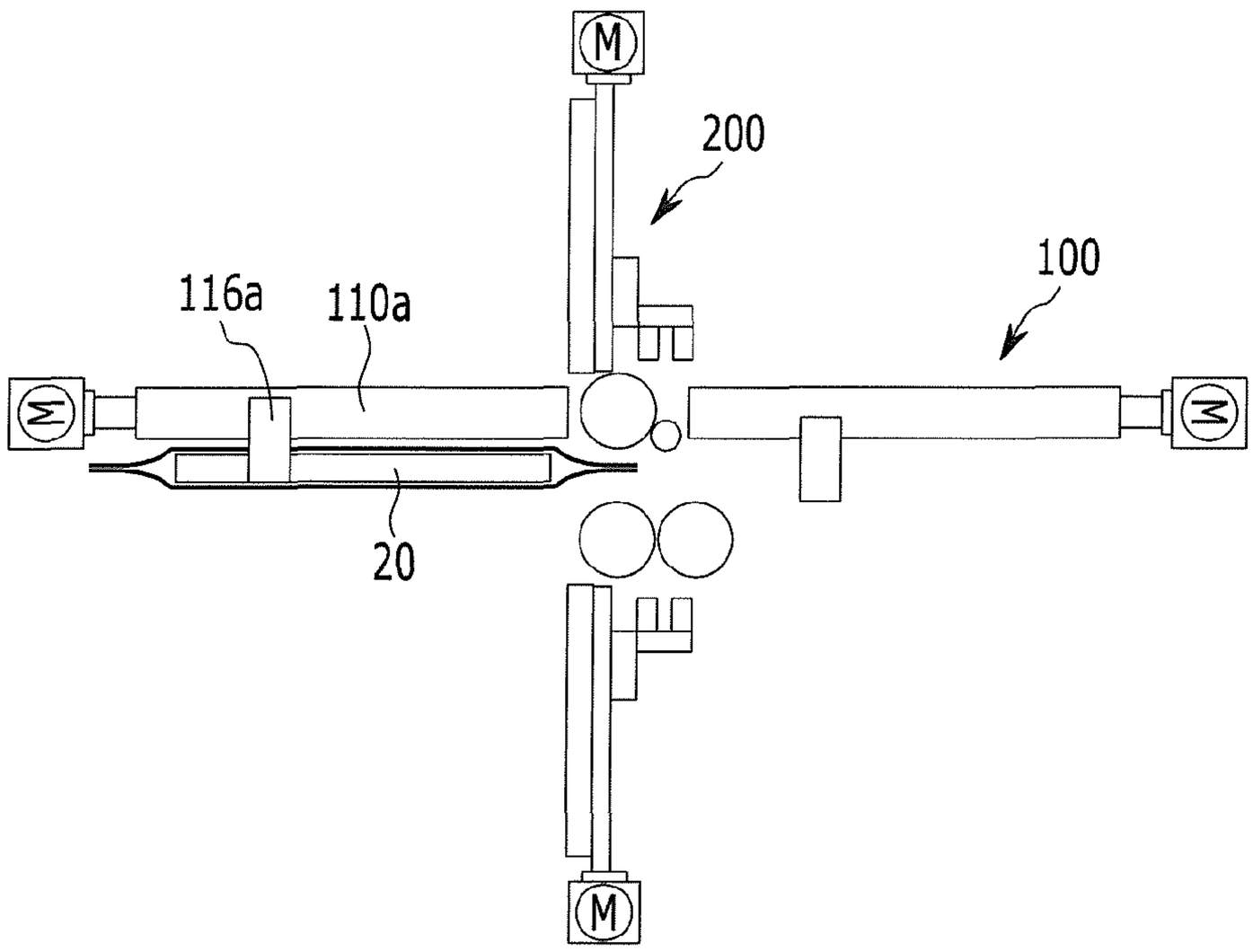


FIG. 7

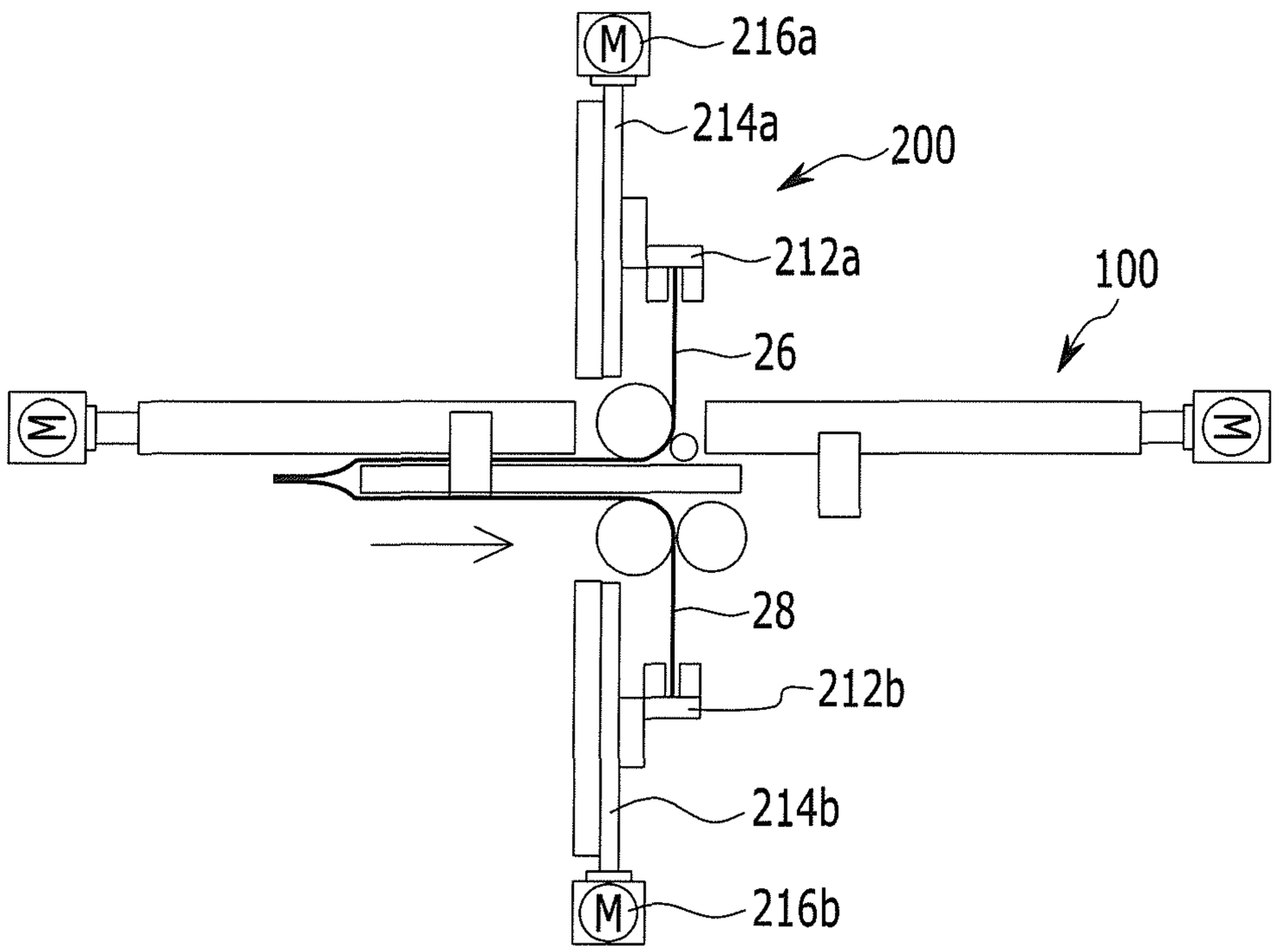


FIG. 8

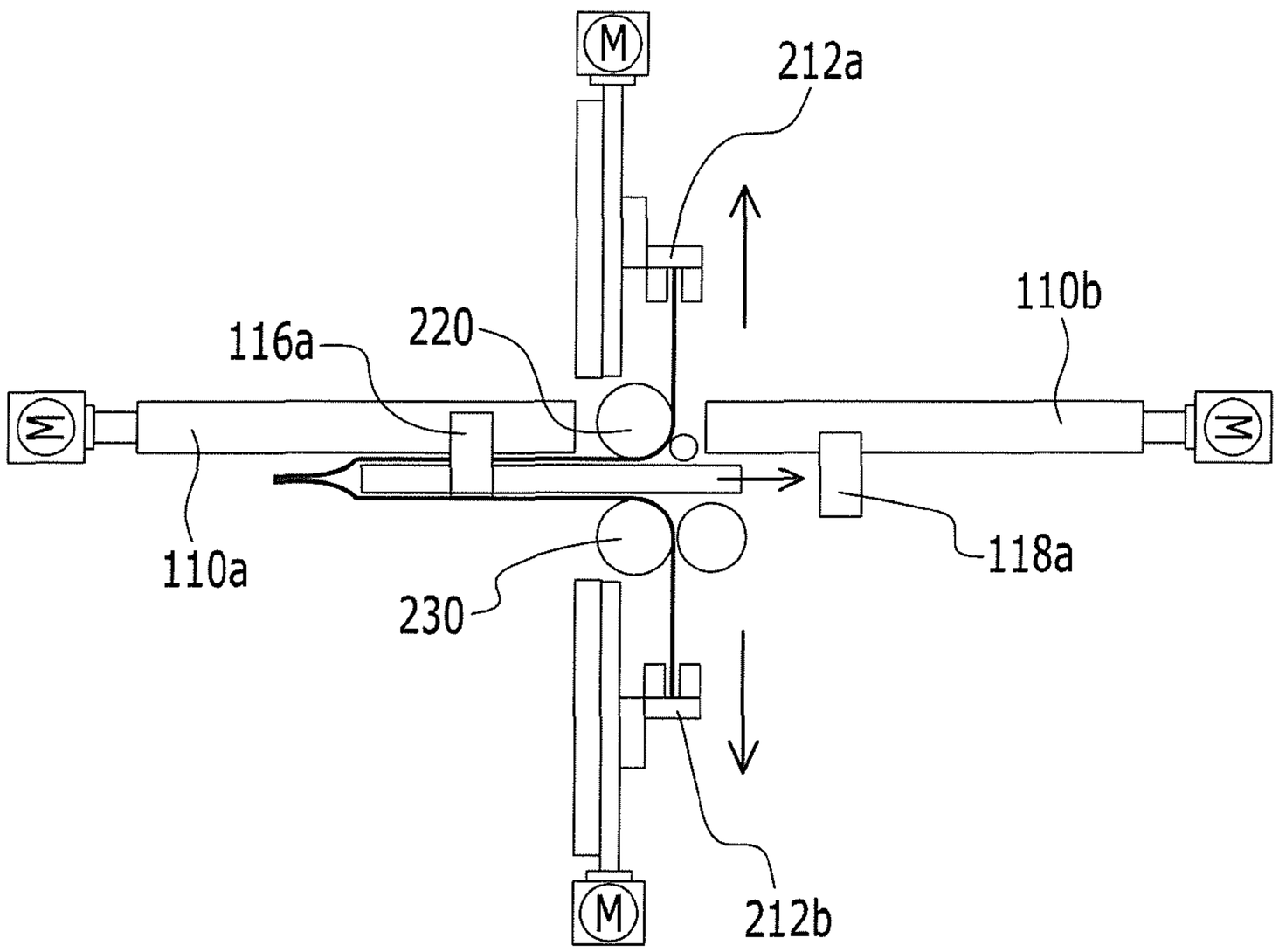


FIG. 9

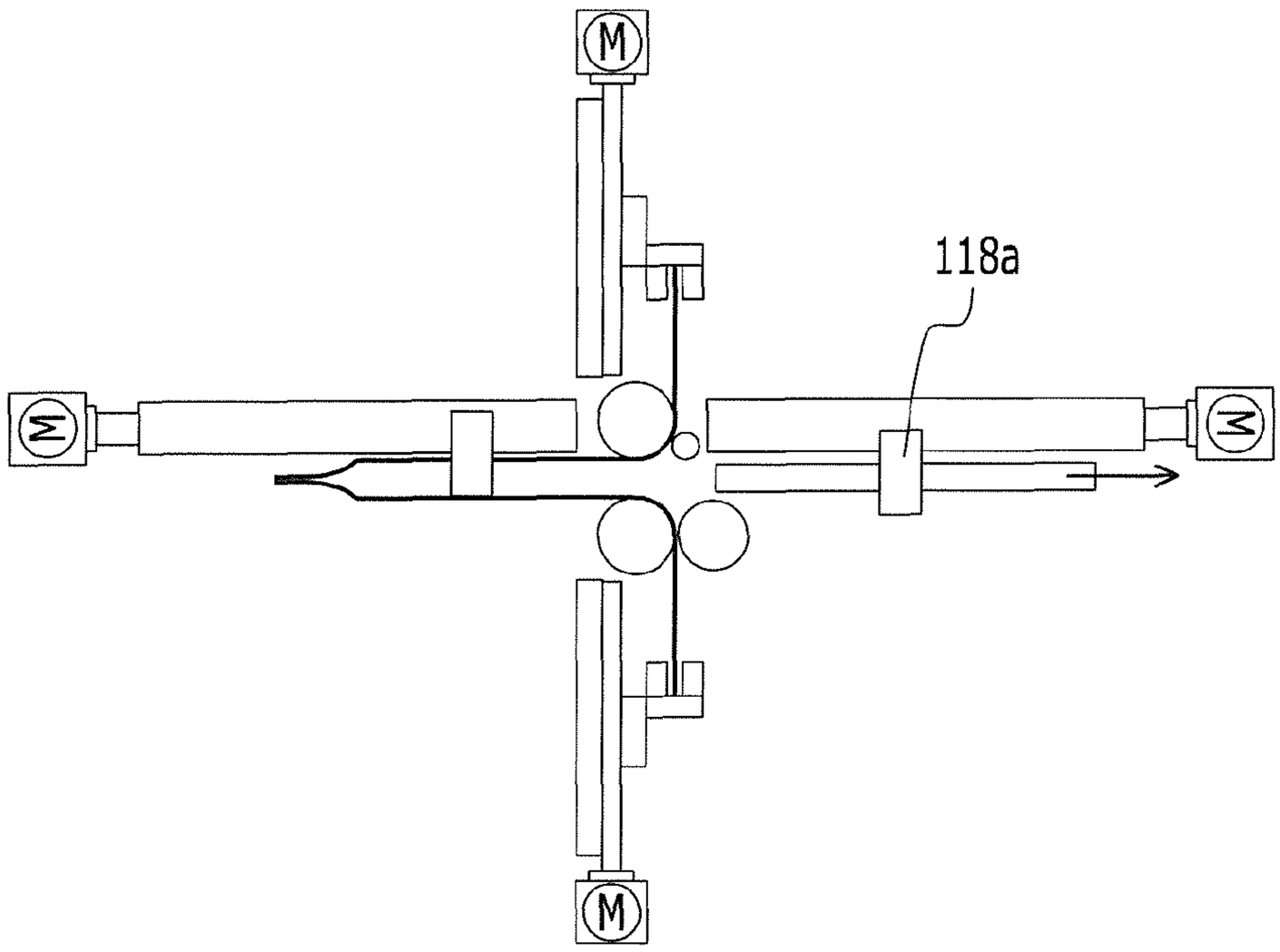


FIG. 10

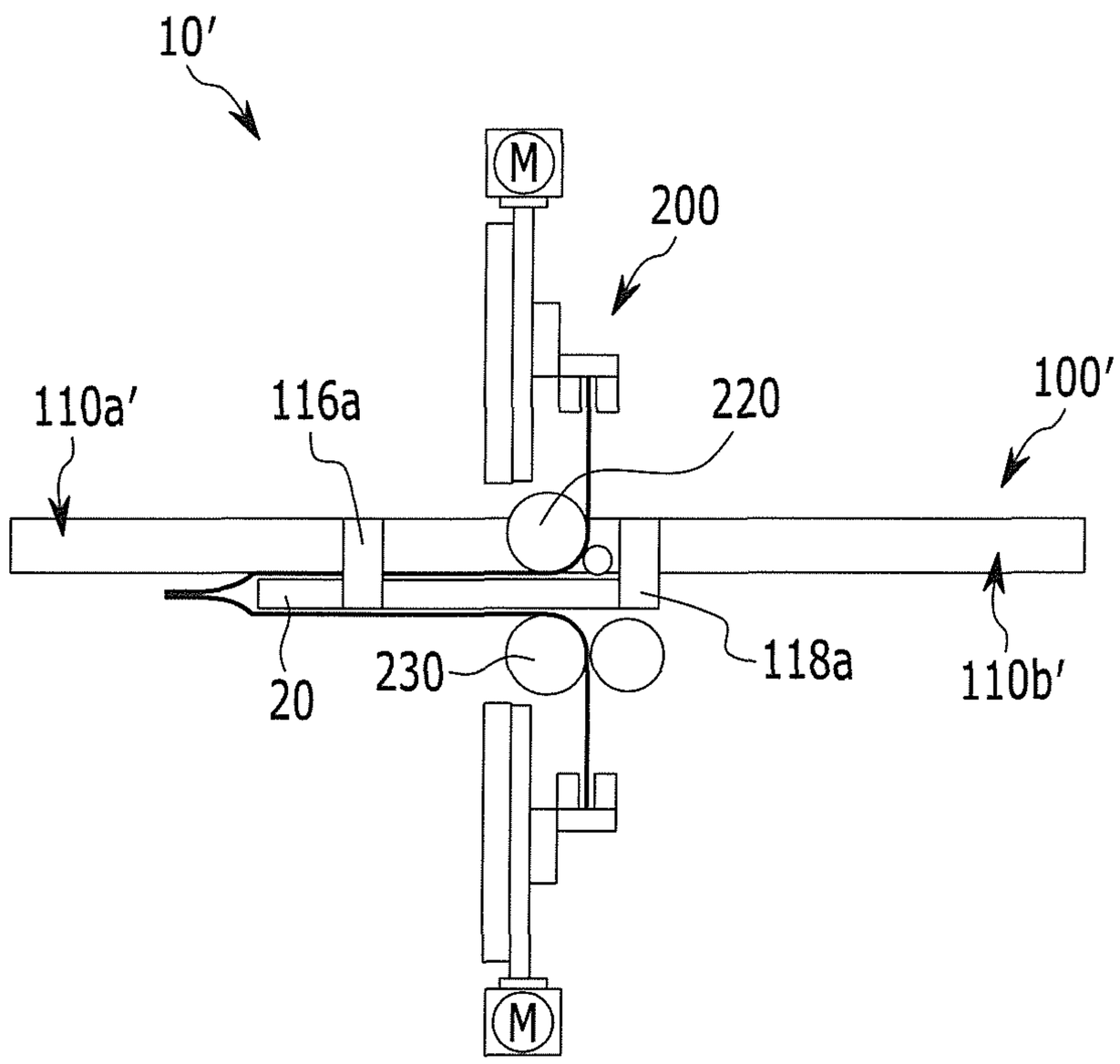
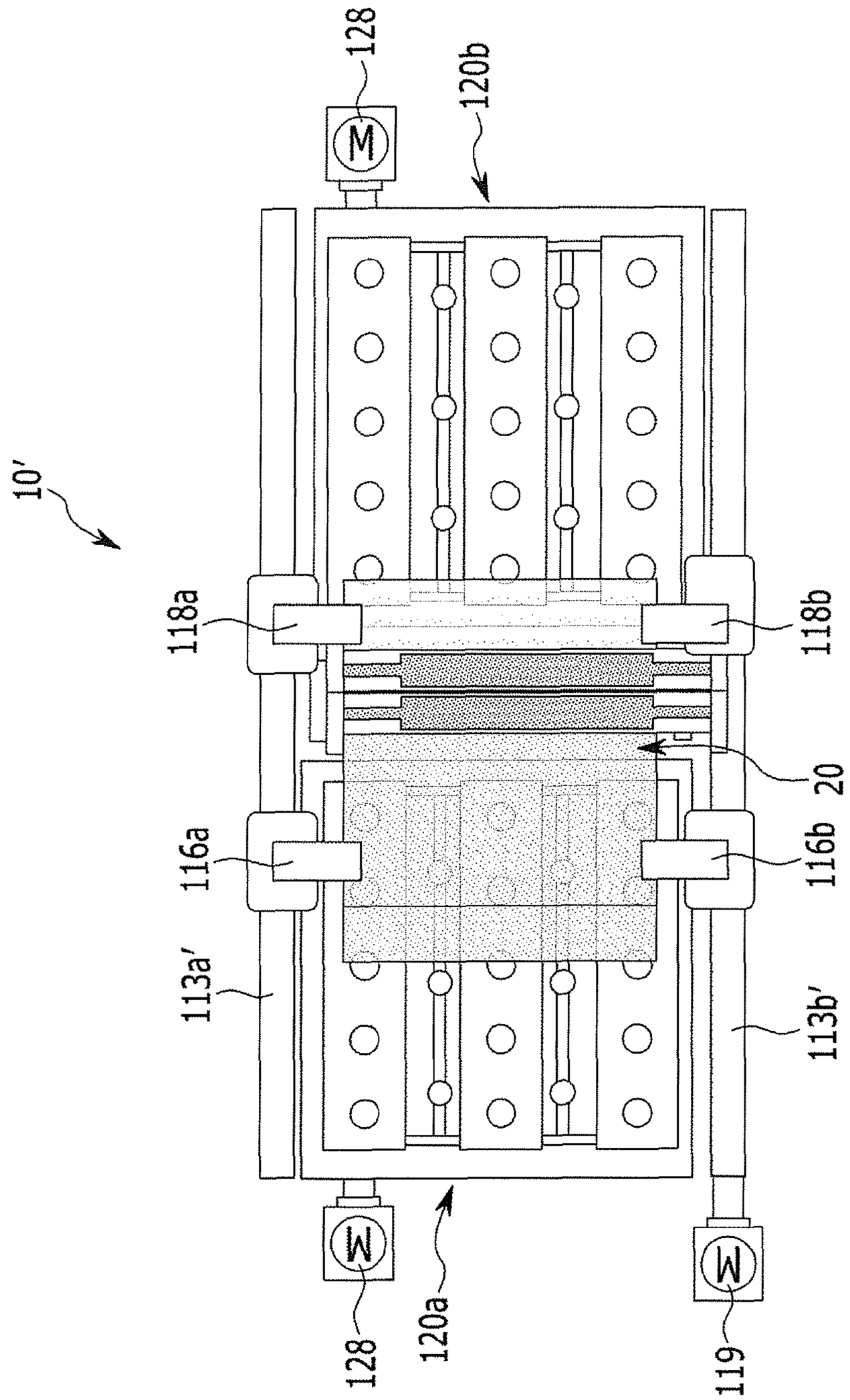


FIG. 11



FILM PEELING DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to and the benefit of Korean Patent Application No. 10-2012-0102876, filed on Sep. 17, 2012 in the Korean Intellectual Property Office, the entire content of which is incorporated herein by reference.

BACKGROUND

1. Field

Aspects of embodiments of the present invention relate to a film peeling device.

2. Description of the Related Art

During a process for manufacturing a display device, such as an organic light emitting diode (OLED) display, a film peeling device for peeling a film provided on a top surface and a bottom surface of a substrate is required so as to protect the substrate, such as a glass substrate on which an organic material is deposited.

Conventionally, the film is peeled while the substrate is disposed horizontally, and as display devices become wider, the substrate droops because of the weight of the substrate when the film of the substrate is peeled while the substrate moves in the horizontal direction, such that the film is not peeled with a uniform thickness.

Also, while the film to which an organic material is provided is peeled, the organic material may fall onto important installed components and pollute or contaminate the environment thereof.

Further, the conventional film peeling device may provide insufficient pressure and force for peeling the substrate of the wide display device, such that uniform peeling rates may not be achieved.

The above information disclosed in this Background section is only for enhancement of understanding of the background of the invention and therefore it may contain information that does not form the prior art that is already known in this country to a person of ordinary skill in the art.

SUMMARY

According to an aspect of embodiments of the present invention, a film peeling device uniformly or substantially uniformly peels a film from a substrate.

According to another aspect of embodiments of the present invention, a film peeling device protects installed components from pollution or contamination by an organic material while a film to which the organic material is transcribed is peeled.

According to an exemplary embodiment of the present invention, a film peeling device for peeling a film from a substrate including a transfer module configured to transfer the substrate that is arranged in a vertical direction with respect to a bottom surface of the substrate, and a peeling module configured to peel the film from the substrate transferred by the transfer module.

The transfer module may include: a front substrate transfer unit at a front side of the peeling module and configured to shift the substrate to the peeling module; and a rear substrate transfer unit at a rear side of the peeling module and configured to shift the substrate peeled by the peeling module.

The front transfer unit and the rear transfer unit may respectively include: an extending guide extended in a substrate transfer direction; a substrate gripper installed on the extending guide, shiftable along the extending guide, and fixable to a side of the substrate; and a first drive motor configured to shift the substrate gripper along the extending guide.

The extending guide, the substrate gripper, and the first drive motor may be arranged as a pair at a top and a bottom of the substrate, respectively.

The extending guides of the front substrate transfer unit and the rear substrate transfer unit may be separated from each other.

The extending guides of the front substrate transfer unit and the rear substrate transfer unit may be integrally formed.

The film peeling device may further include a vacuum chuck module for maintaining the substrate to stand in a vertical direction, wherein the vacuum chuck module includes: a frame; a substrate support including an absorbing hole for providing an air absorbing pressure to the substrate, the substrate support being installed on the frame along the extending guide; and a second drive motor configured to generate power for providing the air absorbing pressure through the absorbing hole.

The peeling module may include a first peeler and a second peeler at respective sides of the transfer module, and the first and second peelers may respectively include: a film gripper fixable to an end of the film; a film gripper guide installed to allow the film gripper to shift; a guide support supporting the film gripper guide; and a third drive motor configured to generate power for shifting the film gripper along the film gripper guide.

The film gripper and the guide support may be extended in a direction that is perpendicular to the substrate transfer direction.

The peeling module may be arranged between the front substrate transfer unit and the rear substrate transfer unit.

The film peeling device may further include a first roller between the front substrate transfer unit and the rear substrate transfer unit and arranged near a side of the substrate shifting along the front substrate transfer unit and the rear substrate transfer unit, and a side roller at a rear side of the first roller with respect to the substrate transfer direction.

The first roller may be a porous peeling roller for absorbing one side of the film, and the side roller may be configured to pressurize both ends of another side of the film.

In one embodiment, while the substrate shifts to the rear substrate transfer unit from the front substrate transfer unit, the film is peeled from the substrate, and the porous peeling roller provides an absorption force for peeling the film from the substrate.

The film peeling device may further include a second roller arranged near another side of the substrate, and a nip roller at a rear side of the second roller with respect to the substrate transfer direction, and pressurized in a direction toward the second roller.

The film may include: a top film attached to one side of the substrate; and a bottom film attached to another side of the substrate, and an organic material layer may be between the top film and the substrate.

According to an aspect of embodiments of the present invention, the film peeling device peels the film while transferring the substrate to which the film is attached in the vertical direction to prevent or substantially prevent non-uniform film peeling caused by drooping of the substrate.

According to another aspect of embodiments of the present invention, the film peeling device prevents or substantially prevents the substrate from being polluted by an organic material when peeling the film that covers the substrate to which the organic material layer is deposited.

In addition, according to another aspect of embodiments of the present invention, the film peeling device peels the film at a uniform or substantially uniform rate and with a uniform or substantially uniform pressure to improve uniformity of the peeled film.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other features and aspects of the present invention will become more apparent by describing in detail some exemplary embodiments thereof with reference to the attached drawings.

FIG. **1** is a top view of a film peeling device according to an exemplary embodiment of the present invention.

FIG. **2** is a side view of the film peeling device of FIG. **1**.

FIG. **3** is a cross-sectional view of a substrate from which a film is peeled by using a film peeling device according to an exemplary embodiment of the present invention.

FIG. **4** is a top view of a film peeling device according to an exemplary embodiment of the present invention to peel a film.

FIG. **5** is an enlarged perspective view of a region "A" of FIG. **4**.

FIG. **6** to FIG. **9** show a process for peeling a film by using a film peeling device according to an exemplary embodiment of the present invention.

FIG. **10** is a top view of a film peeling device according to another exemplary embodiment of the present invention.

FIG. **11** is a side view of the film peeling device of FIG. **10**.

DETAILED DESCRIPTION

In the following detailed description, certain exemplary embodiments of the present invention are shown and described, simply by way of illustration. As those skilled in the art would realize, the described embodiments may be modified in various different ways, all without departing from the spirit or scope of the present invention. Accordingly, the drawings and description are to be regarded as illustrative in nature and not restrictive. Like reference numerals designate like elements throughout the specification.

FIG. **1** is a top view of a film peeling device according to an exemplary embodiment of the present invention. FIG. **2** is a side view of the film peeling device of FIG. **1**. FIG. **3** is a cross-sectional view of a substrate from which a film is peeled by using a film peeling device according to an exemplary embodiment of the present invention. FIG. **4** is a top view of a film peeling device according to an exemplary embodiment of the present invention to peel a film. FIG. **5** is an enlarged perspective view of a region "A" of FIG. **4**.

Referring to FIG. **1** and FIG. **2**, the film peeling device **10** peels a film from one or more surfaces of a substrate on which the film is attached, and includes a transfer module **100** and a peeling module **200**.

In one embodiment, a peeling substance **20** from which the film can be peeled by the film peeling device **10** may be a substrate **22** having respective sides on which a top film **26** and a bottom film **28** are attached, as shown in FIG. **3**.

Here, a plurality of deposited organic material layers **24** may be provided between the top film **26** and the substrate **22**. The organic material layers may not be deposited between the bottom film **28** and the substrate **22**.

The substrate **22** available for peeling the film by the film peeling device **10** may have a size for manufacturing a wide display device; however, the size and type are not restricted by embodiments of the present invention.

In one embodiment, the transfer module **100** of the film peeling device **10** for transferring the substrate **22** includes a front substrate transfer unit **110***a* and a rear substrate transfer unit **110***b*.

The front substrate transfer unit **110***a* is provided at a front side of the peeling module **200** and shifts the substrate to the peeling module **200**, and the rear substrate transfer unit **110***b* is provided at a rear side of the peeling module **200** and shifts the substrate **22** from which the film is peeled by the peeling module **200**.

In one embodiment, the front substrate transfer unit **110***a* includes front extending guides **112***a* and **112***b*, front substrate grippers **116***a* and **116***b*, and a first drive motor **119**, and the rear substrate transfer unit **110***b* includes rear extending guides **114***a* and **114***b*, rear substrate grippers **118***a* and **118***b*, and a first drive motor **119**.

The front extending guides **112***a* and **112***b* and the rear extending guides **114***a* and **114***b* are formed with an extended member that is extended in a transfer direction of the substrate **22**.

The front substrate grippers **116***a* and **116***b* and the rear substrate grippers **118***a* and **118***b* are formed on the front extending guides **112***a* and **112***b* and the rear extending guides **114***a* and **114***b*, respectively, such that they may shift along the front extending guides **112***a* and **112***b* and the rear extending guides **114***a* and **114***b*.

The front substrate grippers **116***a* and **116***b* and the rear substrate grippers **118***a* and **118***b* may be formed with a known combining member such that they may be fixed to one side of the substrate **22**.

In one embodiment, a single substrate gripper may be provided in the film peeling device **10**, or, alternatively, multiple substrate grippers may be provided.

The first drive motor **119** may be combined with the front extending guides **112***a* and **112***b* and the rear extending guides **114***a* and **114***b* so as to shift the front substrate gripper **116***a* and **116***b* and the rear substrate grippers **118***a* and **118***b* on the front extending guides **112***a* and **112***b* and the rear extending guides **114***a* and **114***b*. In this instance, the first drive motor **119** may be a servo motor.

A shift member (not shown) that may be installed in the front extending guides **112***a* and **112***b* and the rear extending guides **114***a* and **114***b* such that the front substrate grippers **116***a* and **116***b* and the rear substrate grippers **118***a* and **118***b* may shift along the front extending guides **112***a* and **112***b* and the rear extending guides **114***a* and **114***b* may be configured with a known shift means such as a ball screw.

In one embodiment, as shown in FIG. **2**, the front extending guides **112***a* and **112***b*, the rear extending guides **114***a* and **114***b*, the front substrate grippers **116***a* and **116***b*, the rear substrate grippers **118***a* and **118***b*, and the first drive motor **119** of the front substrate transfer unit **110***a* and the rear substrate transfer unit **110***b* may be formed as a pair at the top and the bottom of the substrate **22**.

The substrate **22** shifts along the front extending guides **112***a* and **112***b* and the rear extending guides **114***a* and **114***b* while the top and the bottom of the substrate **22** are fixed by the front substrate grippers **116***a* and **116***b* and the rear substrate grippers **118***a* and **118***b* of the front substrate transfer unit **110***a* or the rear substrate transfer unit **110***b*.

In one embodiment, a vacuum chuck module is formed on the front substrate transfer unit **110***a* and the rear substrate transfer unit **110***b*, respectively, such that the substrate **22** may continue to vertically stand with respect to the ground while the substrate **22** moves along the front extending guides **112***a* and **112***b* and the rear extending guides **114***a* and **114***b*.

The vacuum chuck module, in one embodiment, includes a front vacuum chuck **120***a* and a rear vacuum chuck **120***b* provided between the front extending guides **112***a* and **112***b* and the rear extending guides **114***a* and **114***b* of the front substrate transfer unit **110***a* and the rear substrate transfer unit **110***b*.

In one embodiment, the front vacuum chuck and the rear vacuum chuck **120***a* and **120***b* include frames **122***a* and **122***b*, substrate supports **124***a* and **124***b*, and a second drive motor **128**, respectively.

In one embodiment, the frames **122***a* and **122***b* support the substrate supports **124***a* and **124***b* and the second drive motor **128**, and are combined with the front extending guides **112***a* and **112***b* and the rear extending guides **114***a* and **114***b* and are then fixed.

The frames **122***a* and **122***b* may have a generally square form as shown in FIG. **2**, but are not restricted to the square form.

The substrate supports **124***a* and **124***b* are formed in the frames **122***a* and **122***b* in an elongation direction of the front extending guides **112***a* and **112***b* and the rear extending guides **114***a* and **114***b*.

The substrate supports **124***a* and **124***b* are formed to be disposed near the substrate **22** while the substrate **22** shifts along the front extending guides **112***a* and **112***b* and the rear extending guides **114***a* and **114***b*.

In one embodiment, a plurality of absorbing holes **126***a* and **126***b* are formed in the substrate supports **124***a* and **124***b*.

The absorbing holes **126***a* and **126***b* generate an air absorbing pressure to the substrate **22** while the substrate **22** shifts along the front extending guides **112***a* and **112***b* and the rear extending guides **114***a* and **114***b*, such that the substrate **22** may be closely disposed to the substrate supports **124***a* and **124***b*, thereby maintaining the substrate **22** to stand in the vertical direction.

The second drive motor **128** for generating power for generating an air absorbing pressure through the absorbing holes **126***a* and **126***b* while the substrate **22** is moved is installed on a side of the frames **122***a* and **122***b*. In one embodiment, the second drive motor **128** is installed as a pair on opposite sides of the **122***a* and **122***b*.

The front substrate transfer unit **110***a* and the rear substrate transfer unit **110***b* are formed to separate the front extending guides **112***a* and **112***b* and the rear extending guides **114***a* and **114***b*.

The peeling module **200** is installed between the front substrate transfer unit **110***a* and the rear substrate transfer unit **110***b*.

The peeling module **200** peels the film from the substrate **22** when the transfer module **100** transfers the substrate **22**, and the peeling module **200**, in one embodiment, includes a first peeler **210***a* and a second peeler **210***b* installed at respective sides of the transfer module **100**.

In one embodiment, as shown in FIG. **4**, the first peeler **210***a* peels the top film **26** provided at the left side of the direction in which the substrate **22** shifts, and the second peeler **210***b* peels the bottom film **28** provided at the right side of the direction in which the substrate **22** shifts.

In one embodiment, the first peeler **210***a* includes a first film gripper **212***a*, a first film gripper guide **214***a*, a first guide support **218***a*, and a third drive motor **216***a*, and the second peeler **210***b* includes a second film gripper **212***b*, a second film gripper guide **214***b*, a second guide support **218***b*, and a third drive motor **216***b*.

Respective constituent elements of the first peeler **210***a* and the second peeler **210***b* may be disposed to face each other with respect to the substrate **22**.

In one embodiment, the first film gripper **212***a* and the second film gripper **212***b* are fixed to ends of the direction in which the film shifts such that the film may be peeled from the substrate **22**.

The first film gripper **212***a* and the second film gripper **212***b* are formed to shift along the first film gripper guide **214***a* and the second film gripper guide **214***b*.

The first film gripper guide **214***a* and the second film gripper guide **214***b* may be arranged in the vertical direction with respect to the direction in which the substrate **22** shifts, and may be formed to be supported by the first guide support **218***a* and the second guide support **218***b*.

In one embodiment, the first film gripper guide **214***a* and the second film gripper guide **214***b* are formed to have lengths that correspond to a width of the film that is peeled from the substrate **22**.

The third drive motors **216***a* and **216***b* for shifting the first film gripper **212***a* and the second film gripper **212***b* are installed at sides of the first film gripper guide **214***a* and the second film gripper guide **214***b*, respectively.

The first and second film gripper guides **214***a* and **214***b*, and a shift member (not shown) combined with the first and second film gripper guides **214***a* and **214***b* for shifting the first and second film grippers **212***a* and **212***b* can be configured with a guide device such as a known LM guide.

In one embodiment, the first and second film gripper guides **214***a* and **214***b* are vertically arranged with respect to the shift direction of the substrate **22**. However, the present invention is not limited thereto, and, in another embodiment, the first and second film gripper guides **214***a* and **214***b* may be arranged in any directions in which the film can be peeled from the substrate while the substrate **22** shifts and the first and second film grippers **212***a* and **212***b* are combined with the film. Further, the first and second film gripper guides **214***a* and **214***b* may have a curved line or roller shape, rather than the straight-line shape as shown in FIG. **1**.

Referring to FIG. **4** and FIG. **5**, in the film peeling device **10**, a first roller **220** and a side roller **240**, and a second roller **230** and a nip roller **250**, are installed between the front substrate transfer unit **110***a* and the rear substrate transfer unit **110***b* and between the first peeler **210***a* and the second peeler **210***b*.

The first roller **220** is disposed near a side of the substrate **22** that shifts along the front substrate transfer unit **110***a* and the rear substrate transfer unit **110***b* and is formed to contact the side of the substrate **22** while the substrate **22** shifts.

In this instance, the first roller **220** may be a porous peeling roller. Therefore, when the substrate **22** shifts while the top film **26** and the bottom film **28** at the end of the substrate **22** are peeled by the first and second film grippers **212***a* and **212***b*, the first roller **220** generates an air absorbing pressure to the top film and rotates such that the top film **26** is peeled by the first roller **220**.

In this instance, the first film gripper **212***a* shifts along the first film gripper guide **214***a* while combined to one end of the top film **26** such that the top film **26** may be easily peeled from the substrate by the first roller **220**.

In one embodiment, the first film gripper **212***a* does not strongly pull the top film **26** such that a tensile force caused by the film gripper top film **26** may be generated on the top film **26**, but the first film gripper **212***a* guides the top film **26** in a direction that is perpendicular to the substrate transfer direction such that the top film **26** may be easily peeled while unfolded from the substrate **22** by rotation of the first roller **220** that generates an absorption force to the surface of the top film **26**.

Further, with respect to the transfer direction of the substrate **22**, a rolling unit **242** for pressurizing both ends of a surface **26***a* of the top film **26** contacting an organic material layer is formed at both ends of a side roller **240** that is disposed at a rear side of the first roller **220**, and a center portion thereof is formed to not contact the surface contacting the organic material layer.

Accordingly, an organic material of the organic material layer **24** does not contact the side roller **240** such that the problem in which the organic material falls to important components while the film is peeled to pollute the environment of a device is prevented or substantially prevented.

The second roller **230** and the nip roller **250** are installed opposite the first roller **220** and the side roller **240** with respect to the substrate transfer direction such that the bottom film **28** may be peeled.

The second roller **230** is a peeling roller, its position is fixed, and it is formed to be rotatable.

The nip roller **250** is formed to be movable such that it may be pressurized in the direction of the second roller **230**. With respect to the substrate shift direction, while being peeled by the second film gripper **212***b*, the bottom film **28** at a front end of the substrate **22** is inserted between the second roller **230** and the nip roller **250**, and while the substrate **22** moves, the second roller **230** and the nip roller **250** are rotated and the bottom film **28** is peeled from the substrate **22**.

In one embodiment, no additional organic material layer is formed between the bottom film **28** and the substrate **22** such that the bottom film **28** may be easily peeled from the substrate **22** by using a pair of rollers such as the second roller **230** and the nip roller **250** that can mutually pressurize the film.

While the bottom film **28** is peeled by the second roller **230** and the nip roller **250**, the second film gripper **212***b* does not provide a strong tensile force to one end of the bottom film **28** but guides shifting of the bottom film **28**.

A process for peeling a film from a substrate using a film peeling device according to an exemplary embodiment of the present invention will now be described. FIGS. **6** to **9** show a process for peeling a film by using a film peeling device according to an exemplary embodiment of the present invention.

Referring to FIG. **6**, the substrate **22** is combined to the front substrate grippers **116***a* and **116***b* of the front substrate transfer unit **110***a* and is shifted in a direction (e.g., the right direction) (hereinafter the substrate transfer direction).

In one embodiment, in the initial stage in which the front substrate transfer unit **110***a* transfers the substrate **22**, the substrate **22** continues to be disposed in the vertical direction because of the air absorbing pressure generated by the front vacuum chuck **120***a*.

When the substrate **22** is shifted in the substrate transfer direction and the front side of the substrate **22** is passed through the first roller **220** and the second roller **230** with respect to the substrate transfer direction, front ends of the top film **26** and the bottom film **28** installed on the substrate **22** are peeled, and the first and second film grippers **212***a* and **212***b* of the first and second peelers **210***a* and **210***b* of the peeling module **200** are combined to the front ends of the top film **26** and the bottom film **28**.

When the first and second film grippers **212***a* and **212***b* are combined to the top film **26** and the bottom film **28**, the air absorbing pressure of the front vacuum chuck **120***a* is removed and the front substrate grippers **116***a* and **116***b* are separated from the substrate **22**. The substrate **22** is then shifted by the peeling module **200** until the substrate **22** is drawn out.

To peel the top film **26** from the substrate **22**, the first roller **220** and side roller **240** are pressurized while the top film **26** is provided between the first roller **220** and the side roller **240**.

To peel the bottom film **28** from the substrate **22**, the nip roller **250** is pressurized to the second roller **230** while the bottom film **28** is provided between the second roller **230** and the nip roller **250**.

The first roller **220** and the second roller **230** are rotated to peel the top film **26** and the bottom film **28** from the substrate **22**.

The top film **26** is peeled from the substrate **22** by the absorption force of the first roller **220** when the first roller **220** is rotated. The bottom film **28** is peeled from the substrate **22** by the absorption force when the second roller **230** and the nip roller **250** are rotated.

In one embodiment, the top film **26** and the bottom film **28** are peeled at a constant rate by rotation of the first roller **220**, the side roller **240**, the second roller **230**, and the nip roller **250**, and the substrate **22** proceeds in the substrate transfer direction.

The top film **26** and the bottom film **28** are guided in side directions that are perpendicular to the transfer direction of the substrate **22** by the first and second film grippers **212***a* and **212***b* of the first peeler **210***a* and the second peeler **210***b*, and when the substrate **22** is shifted to the rear substrate transfer unit **110***b* through the first roller **220** and the second roller **230**, the top film **26** and the bottom film **28** are completely peeled from the substrate **22**.

At the position where the top film **26** and the bottom film **28** are completely separated from the substrate **22**, the rear vacuum chuck **120***b* of the rear substrate transfer unit **110***b* is operated to maintain the substrate **22** to stand in the vertical direction.

After the rear substrate grippers **118***a* and **118***b* are combined to the substrate **22**, the rear substrate grippers **118***a* and **118***b* transfer the substrate **22** in the substrate transfer direction along the rear extending guides **114***a* and **114***b* to discharge the substrate **22** from which the top film **26** and the bottom film **28** are peeled.

FIG. **10** is a top view of a film peeling device according to another exemplary embodiment of the present invention. FIG. **11** is a side view of the film peeling device of FIG. **10**.

A film peeling device according to another exemplary embodiment of the present invention will now be described, and description of components and configuration the same as those of the film peeling device **10** described above will not be repeated.

A film peeling device **10'** according to another exemplary embodiment of the present invention includes a transfer module **100'** and the peeling module **200**.

The film peeling device **10'** includes a front substrate transfer unit **110***a'* and a rear substrate transfer unit **110***b'* of the transfer module **100'**, and top and bottom extending guides **113***a'* and **113***b'* of the front and rear substrate transfer units **110***a'* and **110***b'* that are integrally formed.

The remaining components and configurations of the film peeling device **10'** correspond to those of the film peeling device **10** described above, except for the integral formation of the extending guides **113***a'* and **113***b'* of the front substrate transfer unit **110***a'* and the rear substrate transfer unit **110***b'*.

When the extending guides **113***a'* and **113***b'* of the front substrate transfer unit **110***a'* and the rear substrate transfer unit **110***b'* are integrally formed according to another exemplary embodiment of the present invention, an inter-axis parallelization degree of the extending guides **113***a'* and **113***b'* of the front substrate transfer unit **110***a'* and the rear substrate transfer unit **110***b'* may not be dislocated.

Regarding the film peeling device **10** according to the above-described exemplary embodiment, when the front extending guides **112***a* and **112***b* and the rear extending guides **114***a* and **114***b* of the front substrate transfer unit **110***a* and the rear substrate transfer unit **110***b* are arranged in series, a vertical degree of the substrate when the substrate is transferred may be maintained, and when the substrate is erroneously shifted during the substrate shifting process, the film peeling process, and the process for shifting the substrate to the rear substrate transfer unit from the front substrate transfer unit, uniformity of the rate for peeling the film from the substrate may not be guaranteed, and in this case, a strain may occur on the substrate to which the organic material is applied.

Compared to this, when the extending guides **113***a*' and **113***b*' are integrally formed in the film peeling device **10**' according to another exemplary embodiment, the first drive motor **119** installed on the extending guide **113***a*' and **113***b*' can shift the substrate by using a single first drive motor **119**, differing from the film peeling device **10**, and, for example, efficiency of equipment configuration can be increased by using a linear motor.

While the present invention has been described in connection with certain exemplary embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims, and equivalents thereof.

What is claimed is:

1. A film peeling device for peeling a film from a substrate, the film peeling device comprising:

a transfer module configured to transfer a substrate that is arranged in a vertical direction from a front side of the transfer module to a rear side of the transfer module in a substrate transfer direction;

a peeling module configured to peel a film from the substrate transferred by the transfer module; and

a first roller comprising a porous peeling roller configured to provide an absorption force for peeling the film from the substrate,

wherein the peeling module comprises:

a film gripper fixable to an end of the film; and

a film gripper guide configured to guide the film gripper having the film fixed thereto away from the first roller film along the film gripper guide.

2. The film peeling device of claim **1**, wherein the transfer module comprises:

a front substrate transfer unit at a front side of the peeling module and configured to shift the substrate from the front side of the transfer module to the peeling module; and

a rear substrate transfer unit at a rear side of the peeling module and configured to shift the substrate peeled by the peeling module from the peeling module to the rear side of the transfer module.

3. The film peeling device of claim **2**, wherein each of the front substrate transfer unit and the rear substrate transfer unit comprises;

an extending guide extended in a substrate transfer direction;

a substrate gripper installed on the extending guide, shiftable along the extending guide, and fixable to a side of the substrate; and

a first, drive motor configured to shift the substrate gripper along the extending guide.

4. The film peeling device of claim **3**, wherein the extending guide, the substrate gripper, and the first drive motor of each of the front substrate transfer unit and the rear substrate transfer unit are arranged at an upper region of the transfer module, and wherein each of the front substrate transfer unit and the rear substrate transfer unit further comprises another extending guide, another substrate gripper, and another first driver motor arranged at a lower region of the transfer module.

5. The film peeling device of claim **3**, wherein the extending guides of the front substrate transfer unit and the rear substrate transfer unit are separated from each other.

6. The film peeling device of claim **3**, wherein the extending guides of the front substrate transfer unit are integrally formed with the extending guides of the rear substrate transfer unit.

7. The that peeling device of claim **3**, further comprising a vacuum chuck module for maintaining the substrate to stand in the vertical direction, wherein the vacuum chuck module comprises,

a frame;

a substrate support including, an absorbing hole for providing an air absorbing pressure to the substrate, the substrate support being installed on the frame along the extending guide; and

a second drive motor configured to generate power for providing the air absorbing pressure through the absorbing hole.

8. The film peeling device of claim **2**, wherein the peeling module comprises a first peeler and a second peeler at respective sides of the transfer module,

wherein the first peeler is configured to peel the film from the substrate and comprises:

the film gripper fixable to the end of the film;

the film gripper guide installed to allow the film gripper to shift along the film gripper guide;

a guide support supporting the film gripper guide; and

a peeling module drive motor configured to generate power for shifting the film gripper along the film gripper guide, and

wherein the second peeler is configured to peel another film from the substrate and comprises:

another film gripper fixable to an end of the another film;

another film gripper guide installed to allow the another film gripper to shift along the another film gripper guide;

another guide support supporting the another film gripper guide; and

another peeling module drive motor configured to generate power for shifting the another film gripper along the another film gripper guide.

9. The film peeling device of claim **8**, wherein the film gripper and the guide support are extended in a direction that is perpendicular to the substrate transfer direction.

10. The film peeling device of claim **8**, wherein the peeling module is arranged between the front substrate transfer unit and the rear substrate transfer unit.

11. The film peeling device of claim **10**, wherein, the first roller is between the front substrate transfer unit and the rear substrate transfer unit and arranged between the first peeler and the second peeler, and

wherein the film peeling device further comprises a side roller at a side of the first roller toward the rear side of the transfer module,

12. The film peeling device of claim 11, wherein the first roller is configured to absorb one side of the film, and the side roller is configured to pressurize both ends of another side of the film.

13. The film peeling device of claim 12, wherein, while the substrate shifts to the rear substrate transfer unit from the from substrate transfer unit, the film is peeled from the substrate.

14. The film peeling device of claim 12, further comprising:

a second roller arranged between the first roller and the second peeler; and

a nip roller at a side of the second roller toward the rear side of the transfer modulo, and pressurized in a direction toward the second roller.

15. The film peeling device of claim 12, wherein the side roller is configured to not contact a center portion of the another side of the film between the ends when pressurizing both ends.

16. The film peeling device of claim 1,

wherein the film peeling device is configured to peel:

a top film attached to one side of the substrate; and

a bottom film attached to another side of the substrate, and

wherein an organic material layer is between the top film and the substrate.

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